LEVELL

INSTRUCTION BOOK

OPERATING INSTRUCTIONS

for

DECADE OSCILLATORS
TYPE TG66 SERIES

GUARANTEE

We undertake to repair, or replace free of charge, any components that fail within 12 months of the date of purchase of an instrument provided that the instrument is not, in our opinion, modified or misused. Instruments returned by post should be well packed to avoid damage. We recommend the use of two strong cartons, one to fit closely around the instrument and the other large enough to float the small carton in at least 2" thickness of wood wool.

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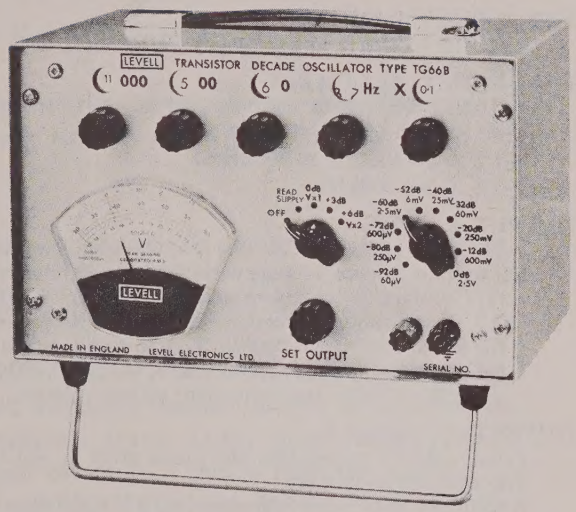
LEVELL

DECADE OSCILLATORS

TYPES TG66A & TG66B

- **0.2Hz to 1.22MHz**
- **PORTABLE**
- **LOW DISTORTION**
- **STABLE FREQUENCY**
- **STABLE AMPLITUDE**



These instruments generate very pure and stable sinusoidal oscillations throughout the wide frequency range 0.2Hz to 1.22MHz. The two versions differ only in respect of the power supply arrangement. Both will operate from either internal batteries or an A.C. mains supply. Type TG66A may be changed from battery to mains operation by a switch on the front panel whereas type TG66B is converted by fitting a LEVELL stabilised Power Supply Unit in place of the batteries.

Frequency is selected by means of four additive decade controls with in-line digital read out and a five position range multiplier switch. The first three decade controls are switches with twelve positions marked 0, 1, 2 . . . 11 and the fourth decade control is continuously variable with a linear calibration of 0 to 12 divided into 60 divisions. This combination permits the frequency to be varied with a discrimination better than $\pm 0.03\%$ or 1/10th of the specified frequency accuracy, whichever is the greater.

The basic oscillator circuit comprises a high gain wide band transistor amplifier with the output fed back in phase to the input through a Wien bridge network. The amplitude of the oscillation is stabilised by a thermistor which controls the degree of negative feedback that is applied to the amplifier. The decade controls vary the resistive components in the Wien bridge arms and the range multiplier switch selects the capacitive components. Considerable care has been taken to ensure that the amplifier has a high input impedance and low output impedance so that the tuning is negligibly affected by variations in the characteristics of the transistors and other components that are used.

A transistor voltmeter is incorporated to monitor the output voltage of the oscillator. The meter has the noteworthy feature of an expanded scale such that a range of -2dB to $+4$dB is presented on a scale length of 3.5″ (9 cm). The output of the oscillator is continuously variable throughout this range so that the amplitude of the oscillation may be varied with a discrimination better than ± 0.05dB over this range. The meter circuit operates by comparing the D.C. output of a peak rectifier circuit against a stable reference voltage that is produced across a zener diode. Very good stability and calibration accuracy are ensured by this combination. The meter is scaled in terms of both dBm and source voltage.

Two step attenuator controls are provided to enable the output to be reduced by up to 98 dB in steps not more than 6dB apart so that continuous control of the output is available throughout a total range of 104dB. The attenuators are fitted with high stability resistors and care has been taken to avoid capacitive by-pass of the attenuator at the high frequency end of the range.

SPECIFICATION OF TYPE TG66 SERIES

FREQUENCY RANGE
0.2Hz to 1.22MHz in five ranges.

FREQUENCY ACCURACY
±0.02Hz below 6Hz.
±0.3% from 6Hz to 100kHz.
±1% from 100kHz to 300kHz.
±3% above 300kHz.

OUTPUT RANGE
−94dBm to +10dBm (10mW) into 600 ohm load with source impedance of 600 ohms ±1% at all settings, i.e. Source Voltage variable from 30 microvolts to 5 volts. Controls comprise:
(a) Continuous control covering −2dBm to +4dBm monitored by a meter with a scale length of 3.5″ (9 cm) calibrated in dBm (power relative to 1mW into 600 ohms) and Source Voltage.
(b) Boost control marked 0dB, +3dB and +6dB; Vx1 and Vx2.
(c) Attenuator control marked 0dB, −12dB, −20dB, −32dB, −40dB, −52dB, −60dB, −72dB, −80dB, −92dB, and equivalent source voltages.

OUTPUT ACCURACY
From −2dBm to +4dBm the meter error is ±0.2dB from 3Hz to 300kHz and ±0.5dB below 3Hz and above 300kHz.
Additional error on +3dB and +6dB is ±0.1dB.
Additional error on −12dB to −92dB is ±0.1dB plus either, ±1% of dB reading up to 300kHz, or, ±3% of dB reading above 300kHz.

VARIATION OF OUTPUT WITH FREQUENCY
±5% from 10Hz to 1.22MHz.
Below 10Hz the output falls by the same percentage as that percentage of the frequency which is set on the fourth digit dial.

STABILITY ON BATTERIES FOR ±10% VARIATION OF 33V SUPPLY
Frequency: ±0.1% up to 100kHz increasing to ±1% at 1.22MHz.
Output Level: ±0.3%.

STABILITY ON MAINS SUPPLY FOR ±6% MAINS VOLTAGE VARIATION
Frequency: ±0.005% up to 100kHz, increasing to ±0.05% at 1.22MHz.
Output Level: ±0.05%.

STABILITY WITH AMBIENT TEMPERATURE VARIATIONS
Frequency: ±0.025% per degree C above 100Hz.
±(0.04% ±0.0002Hz) per degree C below 100Hz.
Output Level: −0.3% per degree C.

HARMONIC CONTENT AT +10dBm OUTPUT
0.15% maximum from 15Hz to 15kHz. 0.5% maximum at 1.5Hz and 150kHz.

RIPPLE AND NOISE LEVEL
−80dB relative to +10dBm into 600 ohms.

TEMPERATURE
The above characteristics are at 25°C but only minor divergencies exist from −10°C to +45°C.

POWER SUPPLIES
Battery Operation: 4 Ever Ready type PP9 batteries provide 33V ±10%, life 400 hours.
Mains Operation: TG66A—200/250V, or 100/125V to special order, 50/60 Hz, 6VA.
TG66B—200/250V, or 100/125V to special order, 50/60 Hz, 6VA, when LEVELL Power Unit type PU33 replaces batteries.

SIZE AND WEIGHT
7″ x 10¼″ x 7″ (18 cm x 26 cm x 18 cm). 12 lbs. (5.4 kg) complete with batteries.

LEATHER CASE TYPE LC3
This case is available as an optional extra. It is stiffened with board and felt lined. A compartment is fitted for stowage of leads. There is a detachable shoulder strap and it is possible to use an instrument whilst it is in a case.

OPERATING INSTRUCTIONS FOR LEVELL TG66 DECADE OSCILLATORS

1. Connection of Internal Batteries.

Remove the rear panel from the oscillator case.

Place four nine volt batteries in the compartments provided and connect to the leads. Battery type is Ever Ready PP9 or equivalent.

Replace the rear panel.

2. Connection to an A.C. Mains Supply. (TG66A only).

The mains supply required is 200/250V, 50/60Hz unless otherwise stated. The supply leads are normally colour coded in accordance with the International convention, Brown Live, Blue Neutral, and Green/Yellow Earth. In case of doubt, check that the earth connection is made to the lead that is joined to the case of the instrument. Batteries may be left inside the instrument whilst it is used on a mains supply but the batteries should be removed when they are exhausted to prevent corrosion.

3. To Check Supply.

Set the mechanical zero adjustment screw on the meter so that the meter reads OdBm when the instrument is switched off. It is normal for the meter to take a minute to reach the zero reading when the instrument is switched off. Turn the "Supply and Output" switch to the test position on "Mains" or "Battery" operation. The meter should read between the supply limits that are marked on the bottom scale.

4. To Select Frequency.

The four in line decade digit controls and the multiplier switch should be set so that the desired frequency is obtained with the use of the lowest value of the multiplier switch.

e.g. To select 1217.5 Hz one has the choice of dial settings of 0, 1, 2, 1.75, x 10 Hz or 1, 2, 1, 7.5, x 1 Hz or, 11, 11, 7, 5, x 0.1 Hz. All three combinations will given an output but the latter is the one which should be used to give the least error in the generated frequency.

5. To set the Output Source Voltage.

The meter has two black scales that are calibrated in terms of the oscillator source voltage. The scales are multiplied by a factor of 1 or 2 as indicated by the black markings on the "Supply and Output" switch. The attenuator switch is marked in black with the full scale reading of the meter voltage scale that is applicable.

The measuring circuit includes a peak rectifier circuit with a storage capacitor that is charged to the peak value of the input waveform once every cycle. The charge on this capacitor decays at a rate low enough to prevent flutter of the meter needle at frequencies above 5 Hz. At frequencies below 5 Hz the needle can be observed to rise to the peak amplitude of the oscillation once every cycle. The maximum value of the needle excursion is thus taken as the amplitude of the signal at all frequencies. The calibration of the meter is given in terms of the rms value of a sinusoidal signal although the peak is actually measured. No error is introduced by this method of measurement since the waveform of the oscillator is an almost pure sine wave.

The output impedance of the oscillator is 600 ohms and the meter reads the source voltage so that the meter reads twice the voltage that exists across the load when the oscillator is terminated with 600 ohms.

It is possible to operate the oscillator with a high or low load impedance in order to obtain the full available output voltage or current. It must, however, be appreciated that the frequency calibration of the oscillator is given for a matched 600 ohm termination and that small errors can be caused at the high frequency end of the range by operation in an unmatched condition.

6. To set an Output Levell in dBm.

The red dBm scale on the meter gives the power produced in a 600 ohm load relative to 1mW. The output can be boosted by +3dB or +6dB by means of the "Supply and Output" switch. The "Attenuator" switch is used to reduce the output in fixed steps as marked on the panel in red. The output level of the oscillator in dBm is thus the sum of the marking in red on the meter and the two control switches.

7. Adjustment of Preset Controls.

There are several preset controls located inside the instrument. These controls are initially aligned and sealed when the instrument is manufactured. Readjustment should not be necessary for many months unless the instrument has had a component failure.

The adjustments are normally made (in the following order) at 20°C on Mains operation with an output of +9dBm into a 600 ohm load: but it is permissible to make the adjustments under other conditions to suit particular circumstances.

(a) Adjustment of D.C. preset controls.

These two controls are adjusted for zero D.C. Voltage on the output. The D.C. Voltage may be detected by placing a D.C. voltmeter of approximately 2 volts f.s.d. across the output terminals.

The controls are the two black potentiometers located nearest to the preset trimming condenser on the small component board behind the meter. The control nearest to the centre of the board is adjusted first at dial settings of 11, 0, 2, 5, x 1 and the other control is then adjusted at dial settings of 0, 0, 2, 5, x 1. The adjustments are slightly interacting so the settings should be repeated until no further adjustment is necessary on either control.

(b) Adjustment of Voltmeter Calibration Controls.

The two controls which are adjusted to set the calibration accuracy of the voltmeter are the red potentiometer and the adjacent black potentiometer which are located on the small component board behind the meter.

The calibration is carried out with reference to an electronic A.C. voltmeter that will measure 1.5 volts and 2.5 volts with an error not greater than $\pm 0.5\%$ at both voltages. The input impedance of this reference voltmeter should not be less than 600 kilohms and the calibration should be made at a frequency between 50 Hz and 5 kHz.

(b) Adjustment of Voltmeter Calibration Controls (continued)

The mechanical zero adjustment screw on the meter should first be set to zero after the instrument has been left switched off for at least one minute. The output of the oscillator should then be set to 1.5 volts as measured on the reference voltmeter. The black potentiometer is then adjusted until the meter on the oscillator reads 1.5 volts.

The output of the oscillator is next set to 2.5 volts with the "Supply and Output" switch at Vx1 and the red potentiometer is adjusted until the meter in the oscillator reads 2.5 volts.

The above procedure is repeated until no readjustment of either control is required. The "Supply and Output" switch is now set at Vx2 and output is reduced by means of the "Set output" control until the reference voltmeter reads 2.5 volts. The meter in the oscillator should now read 1.25 volts $\pm$ 0.02 volts.

(c) Adjustment of the Coverage of "Set Output" Control.

The coverage of the "Set output" control is determined by resistance that is added in series with the thermistor. The value of this resistance will only need to be altered when a thermistor has been changed or has drifted in value due to ageing. The series resistance is set by a green potentiometer that is located on the small component board. (On early models the value is determined by a fixed resistance of value between 0 and 220Ω).

The adjustment is made at dial settings of 2, 0, 0, 0, x 1 so that the "Set output" control covers a range including 2.2 volts to 5.4 volts.

(d) Adjustment of Frequency Accuracy on X100 Range.

This adjustment requires a means of measuring frequencies of 100 kHz and 1.1 MHz to an accuracy of $\pm$ 0.05%.

The accuracy of the calibration on the x100 range is determined by the settings of the capacitive trimmer that is located on the small component board and the green potentiometer that is

(d) Adjustment of Frequency Accuracy on x100 Range (continued)

located on the large component board (on earlier models the green potentiometer is not fitted and the adjustment is determined by a fixed resistance of value between 220Ω and 820Ω that is fitted on the front wafer of the multiplier switch.

The capacitive trimmer is adjusted at 100 kHz on "Mains" operation for dial settings of 1, 0, 0, 0, x 100 and an output of 2 volts across a load of 600 ohms. The green potentiometer (or fixed resistance) is adjusted at 1.1 MHz with dial settings of 11, 0, 0, 0, x 100 and an output of 2 volts across 600 ohms.

It is necessary to repeat these two adjustments until no further adjustment is necessary to give an accuracy of ±0.1% at 100 kHz and ± 0.5% at 1.1 MHz when the instrument chassis is contained within the instrument case.

8. Correction of Frequency Errors due to Ageing of Components.

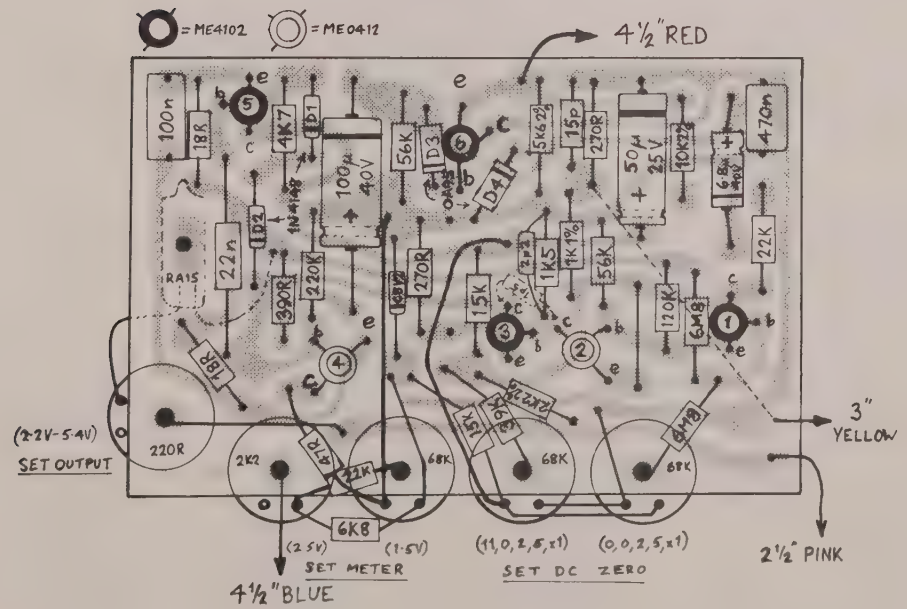
The frequency is determined by the resistors and capacitors used in the Wien Bridge network. The resistors that are used are high stability types which are not liable to drift by an appreciable amount. The capacitors are, however, liable to drift during the first year of operation by an amount which could cause a frequency error of the same order as the specified initial calibration accuracy. This error can be corrected by means of a simple adjustment which is made on each range at digit dial settings of 1, 0, 0, 0, and with an output of 2 volts across a load of 600 ohms. The adjustment on the x100 range is as already described (7d).

It will be found that there are four colour coded leads, in a common sleeve, connecting the front wafer of the multiplier switch to the large component board. The leads are coded green, orange, yellow and grey (or light green) corresponding to connections on the switch which are brought into operation on the x.01, x0.1, x1, and x10 ranges. The leads are soldered to tracks on the large component board which are tapping points on a potentiometer chain that is formed by a number of fixed resistors that are connected in series.

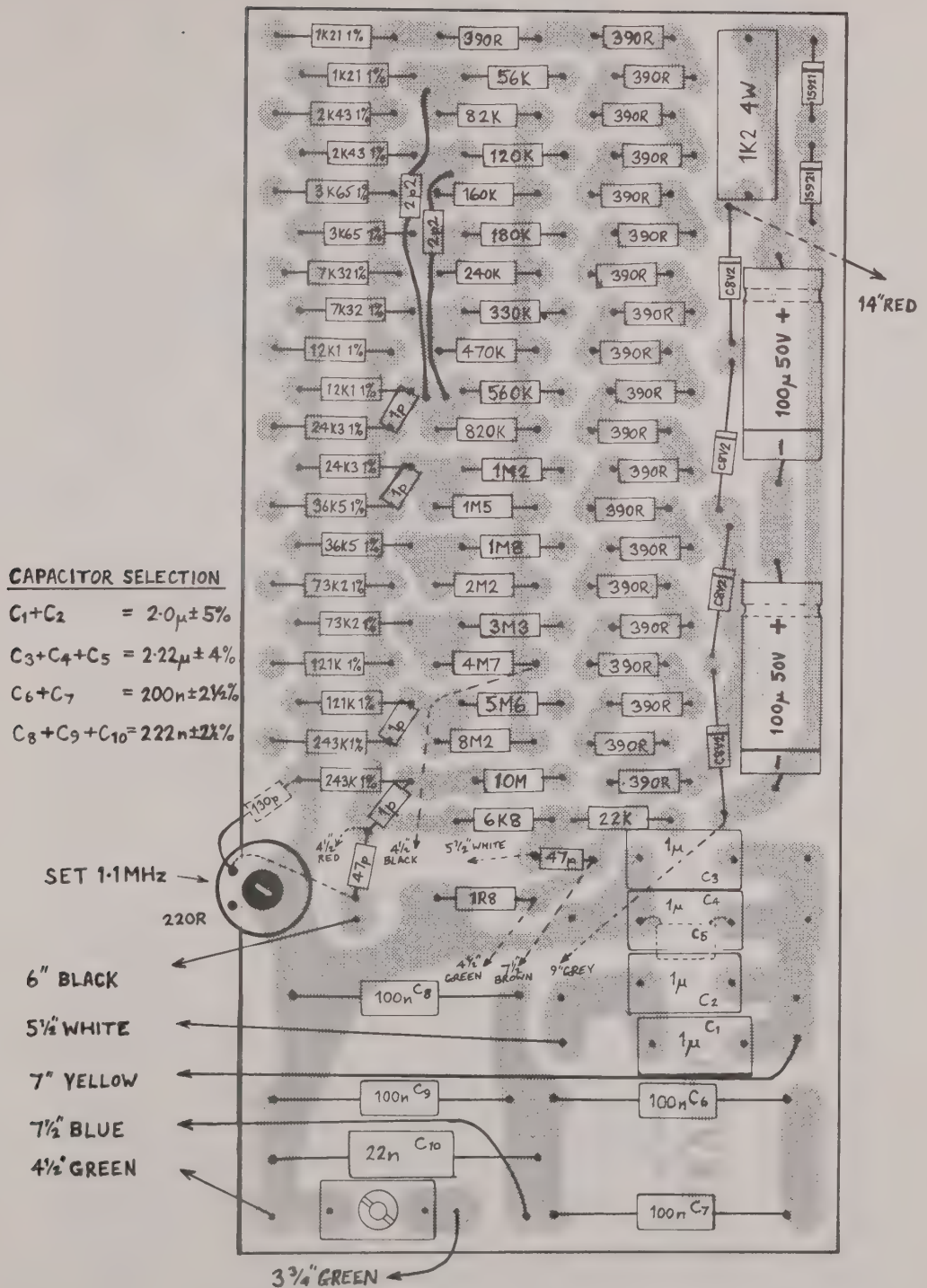
8. Correction of Frequency Errors due to Ageing of Components. (continued)

The frequency adjustment on each range is made by soldering the appropriate lead to the point on the potentiometer chain which gives correct frequency to within ±0.1%. Care must be taken to avoid shorting out sections of the potentiometer chain during this adjustment or the output transistors may be damaged. It is wise to isolate the case of the soldering iron whilst soldering to the tapping points.

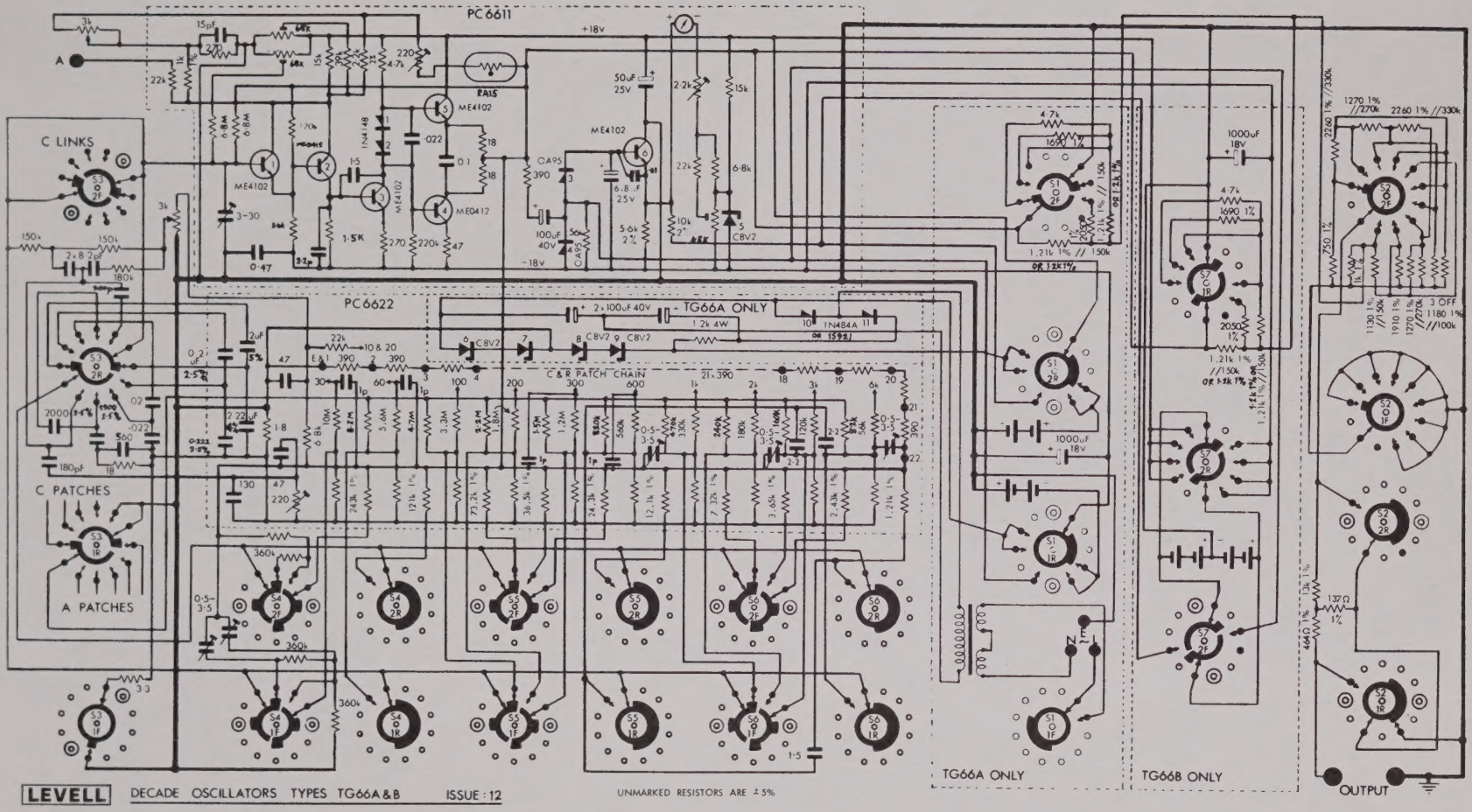
The frequency error may be found to be outside the range of adjustment that is available on the potentiometer chain. The error is then brought within this range of adjustment by connecting or disconnecting links on the rear wafer of the range switch. These links permit the capacity in the lower arm of the Wien Bridge to be increased by adding capacitors in parallel.



COMPONENT SIDE OF PC6611.



COMPONENT SIDE OF PC6622.



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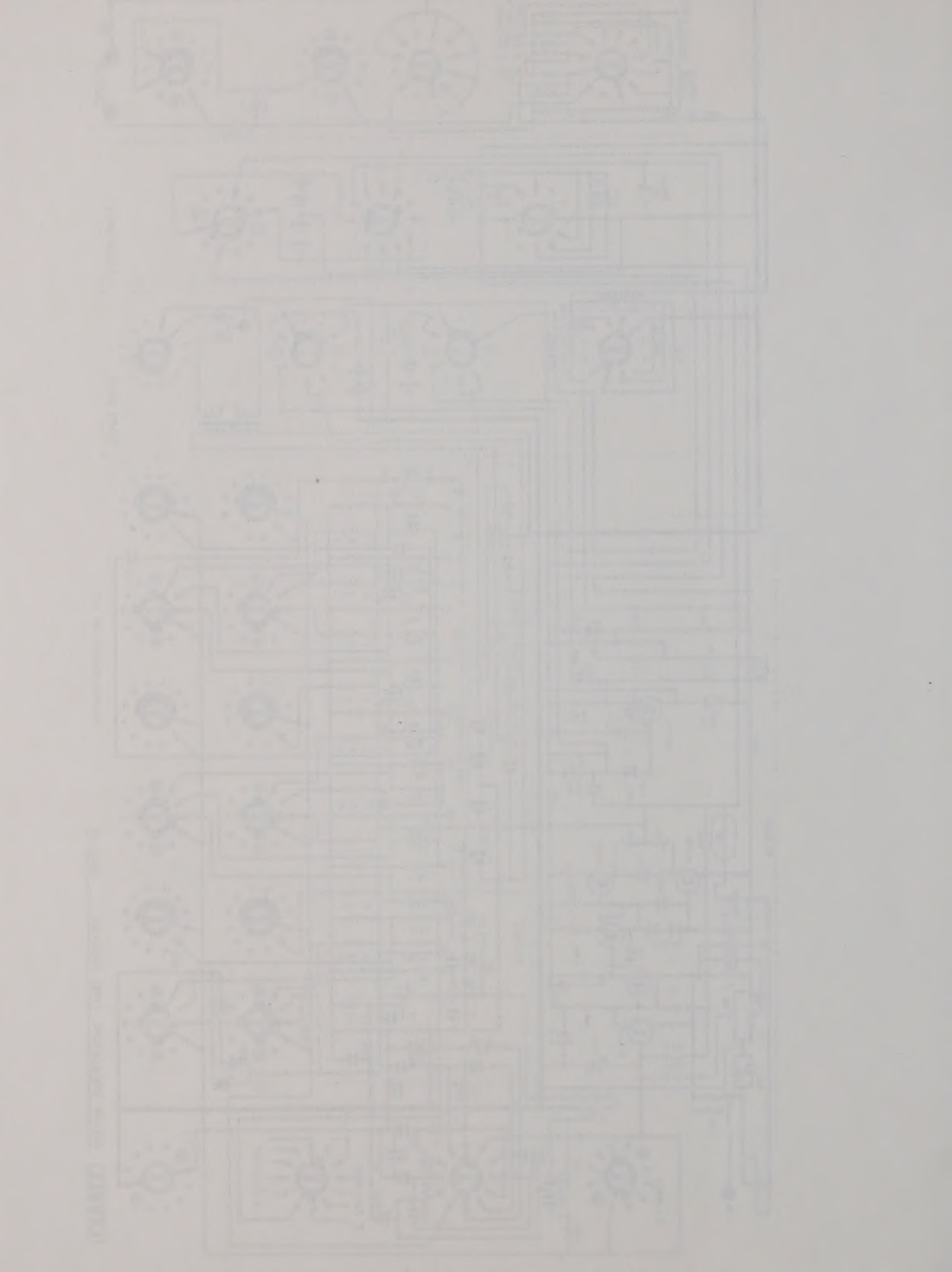

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